AMENDMENTS TO THE SPECIFICATION:

On page 1, immediately following the title please insert headings as follows:

BACKGROUND OF THE INVENTION

Field of the Invention

On page 1, line 6 please insert a heading as follows:

Related Technology

The paragraphs beginning on page 2, line 10 have been changed as follows:

The OLED 100 comprises a glass substrate 102 supporting a plurality of polysilicon and/or metallisation and insulating layers 104 in which the drive circuitry is formed. The uppermost layer of this set of layers comprises an insulating and passivating oxide layer (SiO_2) over which an anode layer 106 is deposited. This anode layer may be formed from ITO (indium tin oxide), for example where the drive circuitry in a layer 104 only occupies part of an area of a pixel and it is desired to provide a substantially transparent device emitting from both sides. However one advantage of a top-emitting device is that the anode need not be transparent and may comprise a conventional metal layer such as a platinum layer.

One or more layers of OLED material 108 are deposited over an anode 106, for example by spin coating and subsequent removal of organic material from unwanted regions (by, for example, laser ablation), or by selective deposition, for example using an inkjet-based deposition process (see, for example, EP0880303). Organic LEDs may be fabricated using a range of materials including polymers, dendrimers, and so-called small molecules, to emit over a range of wavelengths at varying drive voltages and efficiencies. Examples of polymer-based OLED materials are described in WO90/13148, WO95/06400 and WO99/48160; examples of dendrimer-based materials are described in WO02/066552; and

examples of small molecule OLED materials are described in US4,539,507. In the case of a polymer-based OLED layers 108 comprise a hole transport layer 108a and a light emitting polymer (LEP) electroluminescent layer 108b. The electroluminescent layer may comprise, for example, PPV (poly(p-phenylenevinylene)) and the hole transport layer, which helps match the hole energy levels of the anode layer and of the electroluminescent layer, may comprise, for example, PEDOT:PSS (polystyrene-sulphonate-doped polyethylene-dioxythiophene).

A multilayer cathode 110 overlies the OLED material 108 and, in a top-emitting device, is at least partially transparent at wavelengths at which the device is designed to emit. For a polymer LED the cathode preferably has a work function of less than 3.5 eV and may comprise a first layer having a low work function, for example a metal such as calcium, magnesium or barium, and a second layer adjacent the LEP layer 108b providing efficient electron injection, for example of barium fluoride or another metal fluoride or oxide. The top layer of <u>the</u> cathode 110 (that is the layer furthest from LEP <u>layer</u> 108b) may comprise a thin film of a highly conductive metal such as gold or silver. Metallic layers having a thickness of less than 50 nm, more preferably less than 20 nm have been found to be sufficiently optically transparent although it is preferable that the sheet resistance is kept low, preferably less than 100 ohms/square, more preferably less than 30 ohms/square. The cathode layer may be used to form cathode lines which can be taken out to contacts at the side of the device. In some configurations the anode, OLED material, and cathode layers may be separated by banks (or wells) such as banks 112 formed, for example, from positive or negative photoresist material. Banks 112 have an angle of approximately 15° to the plane of the substrate (although in Figure 1 they are shown as having steep sides for ease of representation).

On page 6, line 1 please insert a heading as follows:

GENERAL DESCRIPTION

On page 10, line 1 please insert a heading as follows:

BRIEF DESCRIPTION OF THE DRAWINGS

The paragraph beginning on page 10, line 1 has been changed as follows:

These and other aspects of the ~~present~~ invention will now be further described, by way of example only, with reference to the accompanying figures in which:

The paragraphs beginning on page 10, line 7 have been changed as follows:

Figure 2 shows a cathode layer structure according to an embodiment of the ~~present~~ invention;

Figure 3 shows an OLED incorporating the cathode structure of ~~figure~~ Figure 2;

The paragraph beginning on page 10, line 15 has been changed as follows:

Figure 5 shows a simplified schematic diagram of optical rays used to model the structures of ~~figures~~ Figures 4a and 4b; and

Figures 6 shows transmission and reflectivity spectra for the structures of ~~figures~~ Figures 4a and 4b.

On page 10, line 20 please insert a heading as follows:

DETAILED DESCRIPTION

The paragraphs beginning on page 10, line 21 have been changed as follows:

Referring to ~~figure~~ Figure 2, this shows a model of a cathode structure 200 according to an embodiment of the present invention. The structure comprises a first layer 202, for example of calcium or barium and having a refractive index n_1, followed by a spacer layer

204, for example of ITO or zinc selenide and having a refractive index n_2, followed by a third layer 206, for example of gold, having a refractive index n_3. The first and third layers 202, 206 are preferably sufficiently thin to be substantially transparent to light of a relevant wavelength (generally the peak emission wavelength of the OLED in which the structure is incorporated) ~~whilst~~ while the spacer layer 204 is of approximately quarter wavelength optical thickness. The optical thickness of the interference layer may be determined by multiplying the mechanical thickness of the layer by the refractive index of the layer at the relevant wavelength (in the green region of the spectrum $n_{ITO} \approx 1.85$).

Light 208, for example from an electroluminescent layer in an OLED propagating out through the cathode structure 200, is reflected at the two internal interfaces of the layer 204 with layers 202 and 206 respectively, resulting in reflected beams 210, 212. A full optical analysis of the structure shows that when the optical thickness h (= $n_2 t$) of the layer 204, where t is the physical thickness of the layer, is equal to a quarter wavelength, beams 210 and 212 destructively interfere, ~~minimising~~ minimizing reflected light and ~~maximising~~ maximizing the transmitted light. In an ~~optimisation~~ optimization for a practical device reflections from other internal interfaces and from interfaces with the metal layers are taken into account and this can alter the optimum thickness of the layer 204 from the theoretical quarter wavelength thickness predicted by this simple model.

Figure 3 shows an example of a top-emitting OLED structure 300 incorporating such a cathode structure. In the structure of ~~figure~~ Figure 3 like elements to those of ~~figures~~ Figures 1 & 2 are indicated by like reference numerals and the OLED is forward biased by a battery 302.

Referring now to ~~figure~~ Figure 4a, this shows a schematic diagram of a substantially fully transparent OLED structure 400 without a cathode incorporating an optical interference layer. The layers in the structure 400 (which are not to scale) comprise a layer of glass 402, silicon monoxide 404, gold 406, calcium 408, barium fluoride 410, a yellow emitting

electroluminescent polymer layer 412, a layer of PEDOT 414, an ITO anode layer 416, a layer of silicon dioxide 418, and a further glass layer 420. The gold 406, calcium 408 and barium fluoride 410 together comprise the cathode.

Figure 4b shows a similar OLED structure 450, in which like elements are indicated by like reference numerals. The OLED 450, however, incorporates an additional layer of ~~aluminium~~ aluminum doped silicon monoxide (SiO:Al) 452 within the cathode. The thickness of this layer is selected, as described further below, to enhance transmission from electroluminescence from the layer 412 out through the cathode layers 410, 408, 452, 406 and thence through the silicon monoxide and glass layers 404, 402 by means of destructive interference to inhibit internal reflectance from the cathode layer. The silicon monoxide layer 404 is used as a capping layer for the cathode and does not play any significant part in enhancing transmission through (and reducing reflection from) the cathode.

Figure 5 shows an optical schematic diagram of the device of ~~figure~~ Figure 4a illustrating, in simplified form, some of the optical paths used to model the device; a similar set of paths may be used to model the device of ~~figure~~ Figure 4b. Thus ~~figure~~ Figure 5 shows a transmitted beam 501a from the electroluminescent layer 412 to the top or front of the device and a second transmitted beam 501b from the electroluminescent layer out of the back or bottom of the device. Rays 504, 506 show a reflection of ambient light from the front of the device and rays 508, 510 show a reflection of ambient light from the back of the device. Some ambient light is also transmitted through the device, along the rays 500 and 502. In practice it is preferable to take account of transmission paths from the electroluminescent layer 412 through all of the layers in the forward or top (and optionally backward) direction, considering the effects of all the internal interfaces, when modelling the optical system. Such a calculation may be performed by any one of a number of standard optical methods such as are disclosed in OPTICS by Eugene Hecht (Addison Wesley).

The paragraph beginning on page 14, line 19 has been changed as follows:

To model the cathode structure of ~~figure~~ Figure 4b the additional data shown in table 2, below, was employed.

The paragraph beginning on page 15, line 5 has been changed as follows:

Figure 6 shows a graph of transmission and reflectivity against wavelength through the structures 4a and 4b as predicted by the above mentioned optical design software. Curves 600 and 601 show the reflectivity and transmission through the structure 4a ~~whilst~~ while curves 602 and 603 show the reflectivity and transmission through structure 4b. It can be seen that the structure of the ~~figure~~ Figure 4b provides a significant reduction in the reflectivity whilst while causing an increase in the transmission through the structure when a cathode incorporating an optical interference layer is used, as compared to a similar cathode without such an interference layer.